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(54) **MAGNETIC TUNNEL JUNCTION MAGNETORESISTIVE DEVICE**

(57) The disclosed magnetoresistive device (200) includes a magnetically fixed region (214, 240) and a magnetically free region (250) positioned on opposite sides of a tunnel barrier region (230), and at least a first transition region (220) and a second transition region (221) positioned between the magnetically fixed region and the tunnel barrier region. The first transition region includes a non-ferromagnetic transition metal, preferably pure Ta, and the second transition region includes an alloy including iron and boron, preferably FeB with at least 50 at% boron.

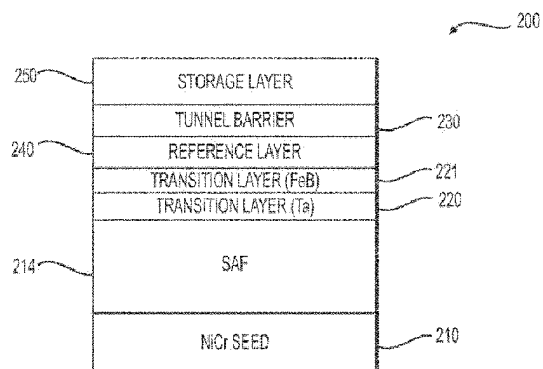


FIG. 4



EUROPEAN SEARCH REPORT

Application Number

EP 24 16 8941

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	* page 1, right-hand column, paragraph 2 - page 2, left-hand column, paragraph 1; figure 1 *	4,6	
X	YAKUSHIJI K ET AL: "Perpendicular magnetic tunnel junctions with strong antiferromagnetic interlayer exchange coupling at first oscillation peak", APPLIED PHYSICS EXPRESS, vol. 8, 083003, 22 July 2015 (2015-07-22), XP055631515, ISSN: 1882-0778, DOI: 10.7567/APEX.8.083003	1-3,5,7	
A	* page 3, left-hand column, paragraph 2 - right-hand column, paragraph 1; figure 3a *	4,6	
X	WO 2018/063338 A1 (INTEL CORP [US]) 5 April 2018 (2018-04-05) * paragraphs [0052] - [0058]; figure 12 *	1,6	
X	US 2016/284763 A1 (TAHMASEBI TAIEBEH [SG] ET AL) 29 September 2016 (2016-09-29) * paragraphs [0068] - [0081]; figure 5a *	1,6	
-The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 11 July 2024	Examiner Köpf, Christian
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 03.82 (P04C01)

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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

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☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

**LACK OF UNITY OF INVENTION
SHEET B**

Application Number

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The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-7

Method of fabricating a magnetoresistive stack comprising forming a fixed region above a first electrode, wherein the fixed region includes a synthetic antiferromagnetic (SAF) region and multiple transition regions thereon, forming a tunnel barrier above the fixed region, and forming a free region above the tunnel barrier

2. claims: 8-15

Magnetoresistive device comprising a fixed region and a free region on opposite sides of a tunnel barrier, and multiple transition regions positioned between the fixed region and the tunnel barrier, wherein the transition regions include at least a first transition region including a non-ferromagnetic transition metal and a second transition region including an amorphous alloy (iron-boron alloy)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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11-07-2024

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